FEMI 209:480598

# FLOOD INSURANCE STUDY

ORIGINAL

48

## CITY OF GRAPEVINE, TEXAS

### TARRANT AND DALLAS COUNTIES

MAY 17, 1982

Federal Emergency Management Agency

COMMUNITY NUMBER - 480598

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY
GRAPEVINE, TEXAS

# 1.0 INTRODUCTION

## 1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Grapevine, Tarrant and Dallas Counties, Texas, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Grapevine to the regular program of flood insurance by the Federal Emergency Management Agency (FEMA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3 (d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

## 1.2 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by U.S. Army Corps of Engineers, Fort Worth District, for the Federal Emergency Management Agency, under Interagency Agreement No. (IAA)-H-9-79, Project Order No. 8. This study was completed in January 1981.

## 1.3 Coordination

Community base map selection and the identification of streams requiring detailed study were done during the initial coordination meeting held on February 8, 1979, attended by the city coordinator, the Community Coordination Officer (CCO), and a U.S. Army Corps of Engineers (COE) representative. The Soil Conservation Service (SCS), the U.S. Geological Survey (USGS), the State Department of Highways and Public Transportation, and the Texas Department of Water Resources were contacted for information related to the study. A final coordination meeting was held on August 26, 1981 in Grapevine, at which time the results of this study were reviewed with community officials. The COE and FEMA officials were represented at this meeting. The study was acceptable to the community.

## 2.0 AREA STUDIED

### 2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Grapevine.

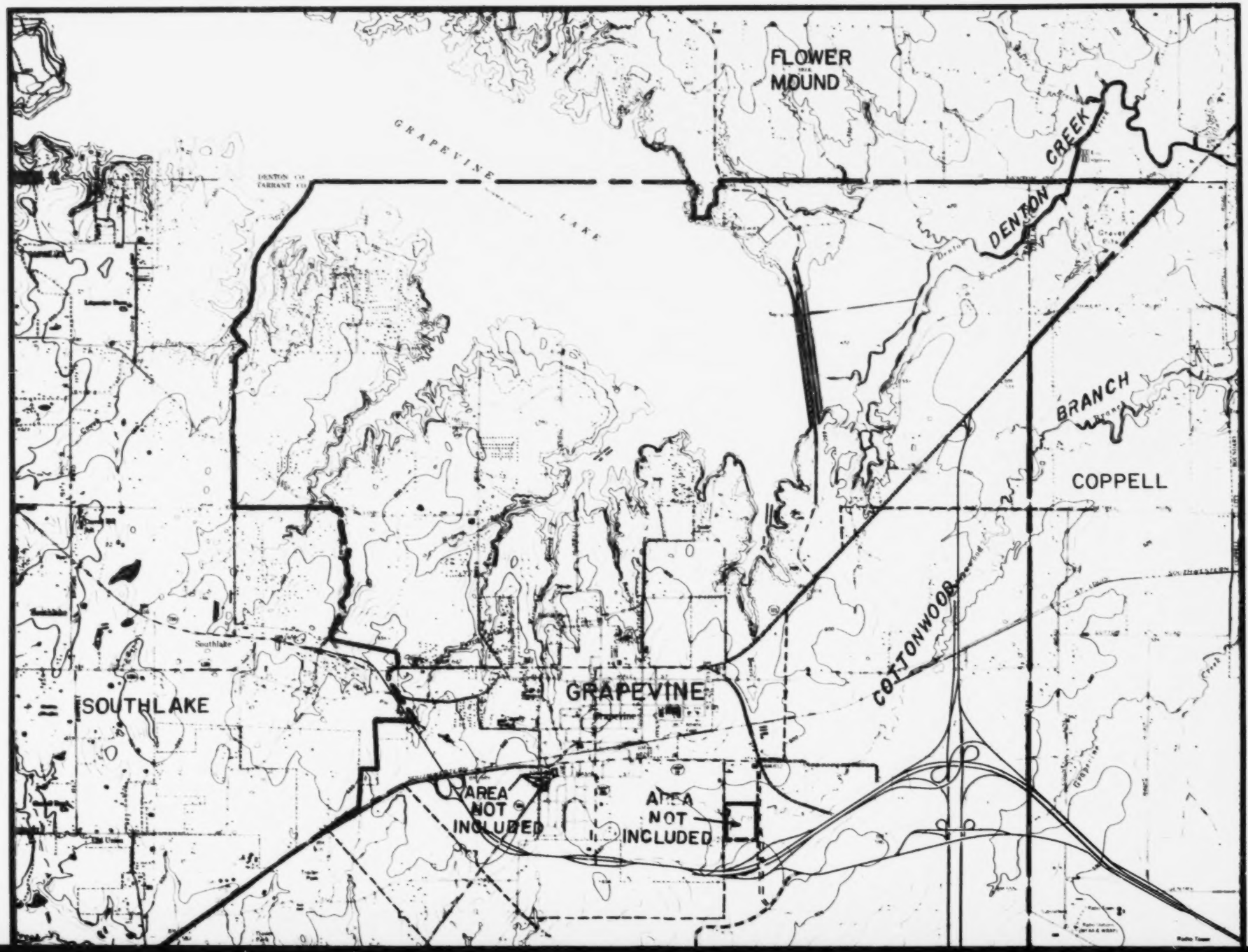
The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction for the next five years, through 1986.

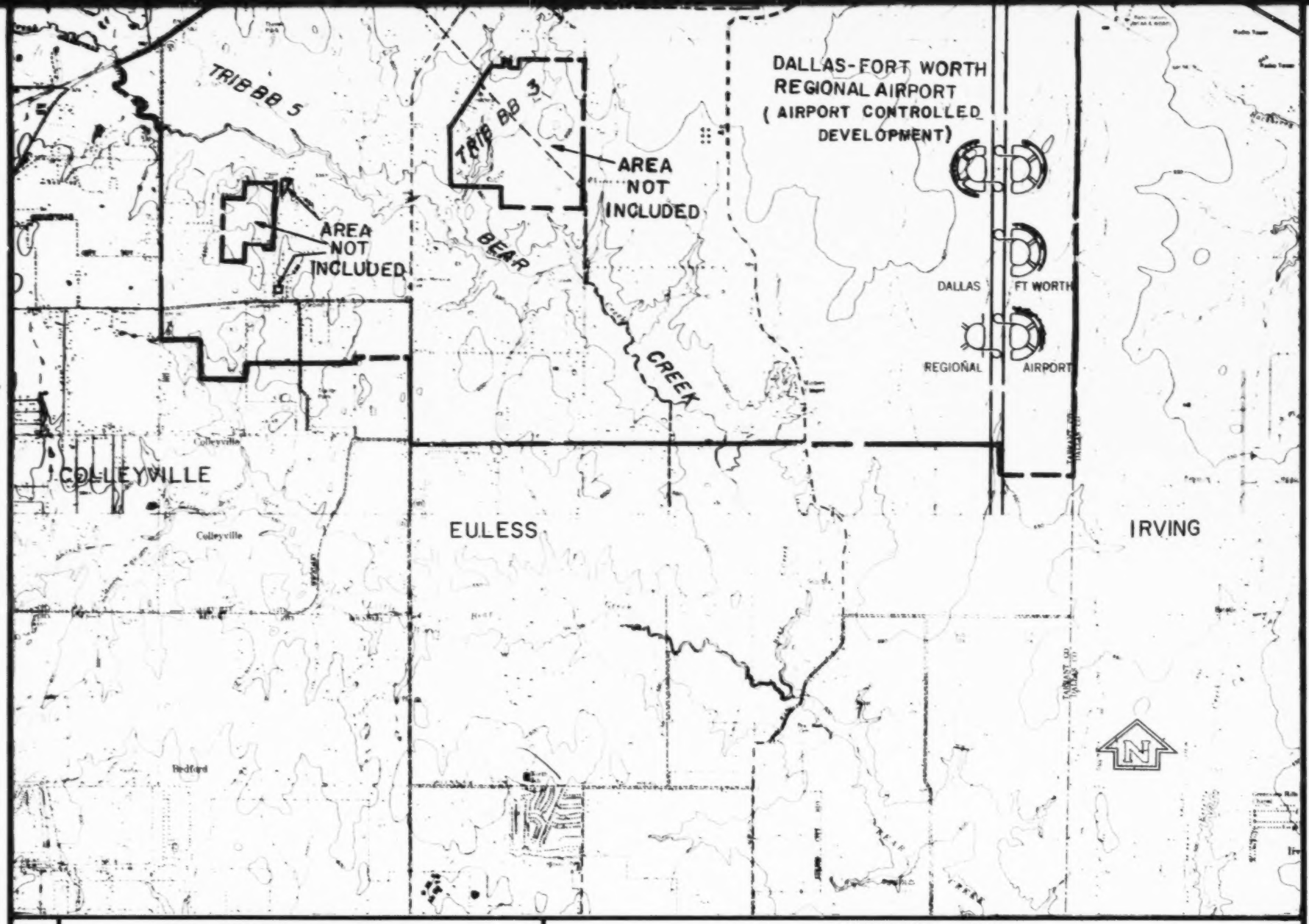
Detailed hydrologic and hydraulic studies were made on all streams in the community having a drainage area of more than 1 square mile. Also studies made for those streams within the boundary of Dallas/Fort Worth Regional Airport and Federal Government property adjacent to Grapevine. Development inside the airport boundary is controlled by the Dallas/Fort Worth Regional Airport. Within the incorporated limits of the City of Grapevine are two parcels of unincorporated land. Tributary D-1 was not studied because the drainage area beyond the Government property line was less than 1 square mile. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by FEMA, and the city officials.

### 2.2 Community Description

Grapevine is located in north central Texas south of Grapevine Lake in the northeast corner of Tarrant County and the northwest corner of Dallas County. The total land area within the town is about 34 square miles, and it is situated about 19 miles northeast of downtown Fort Worth. Grapevine is bounded on the north by Denton County, on the east by the Cities of Irving and Coppell, on the south by the Cities of Euless and Colleyville, and on the west by the Cities of Colleyville and Southlake. The Department of Commerce, Bureau of the Census, quoted the 1980 population as 11,722. Grapevine is primarily a residential community with some commercial and industrial development. The topography is gently rolling to almost level, with elevations in the community varying from about 460 to 680 feet National Geodetic Vertical Datum of 1929 (NGVD). The soils in the area are generally deep loamy surface soils with clayey subsoils. The native vegetation in the undeveloped areas consists of bunch and short grasses with scattered oak, elm, and mesquite trees. The south side of Grapevine is drained by Bear Creek and several of its tributaries. The north side of the city is drained by Denton Creek, several of its tributaries below Grapevine Dam, and by Grapevine Lake. The Grapevine area has a generally mild climate with a large range of annual and daily temperatures. Freezing temperatures and snowfall are occasionally experienced during winter months. Summer temperatures are hot with moderately warm nights. The mean annual temperature in the area is about 66 degrees F. Extremes in temperature range from a minimum of minus 8 degrees F to a maximum of 113 degrees F. The mean annual rainfall is 32.3 inches.


FLOWER MOUND
GRAPEVINE LAKE
DENTON CREEK
BRANCH
COPPELL
COTTONWOOD
SOUTHLAKE
GRAPEVINE
AREA NOT INCLUDED
AREA NOT INCLUDED

3




3A

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

**CITY OF GRAPEVINE, TX**

**(TARRANT AND DALLAS COS.)**

APPROXIMATE SCALE

0 4000 8000 12000 16000 FEET

**VICINITY MAP**

BEST DOCUMENT AVAILABLE

## 2.3 Principal Flood Problems

Most of the flood producing storms that occur in the Grapevine area are experienced in the spring and fall. Most of the higher floods that have occurred in the general geographical region have resulted from prolonged or successive storms that produce heavy rainfall during this period; however, severe flooding can be produced by intense local thunderstorms at any time.

There are two USGS stream gages that provide information pertinent to the study area. The stream gaging station on Bear Creek at State Highway 26 (old Highway 121) was established in 1966. Due to the short duration of records at this station, most of the historical flood information on Bear Creek was obtained from the Bear Creek Flood Plain Information Report published in 1971 (Reference 1) and interviews with local residents. From these sources it is known that large floods occurred in 1935, 1942, 1949, 1957, 1962, 1964, and 1966. The relative magnitudes of these historical floods vary from one reach of the stream to the other due primarily to differences in rainfall intensity and volume at different points in the watershed; therefore, no attempt was made to estimate the recurrence interval.

The stream gage on Denton Creek located at Highway 121 was established in October 1947 (Reference 2). According to local resident interviews, historical data for Denton Creek begins in 1908 with a major flood which is the maximum known in the lower basin. However, no high water marks or related stage heights have been recorded. A flood in April 1942 reached 35.9 stage feet (from highwater marks) at the gage and is thought to be the second largest. Grapevine Dam, completed in 1952, regulates flows at the gage except those from a 10.3 square mile local area between the dam and the gage.

## 2.4 Flood Protection Measures

Grapevine Dam on Denton Creek is the only major flood control project affecting the study area. The reservoir, providing flood control, water supply, and recreation, was placed in operation in 1952.

The City of Grapevine currently regulates flood plain development through a zoning ordinance.

# 3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, and 500-year period (recurrence intervals), have been selected as having special significance for flood plain management and for flood insurance premium rates.

These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one percent chance of annual occurrence) in any 50 year period is about 40 percent (four in 10), and for any 90 year period, the risk increases to about 60 percent (six in 10). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

## 3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail in the community.

Each stream was divided into subareas, and synthetic unit and flood hydrographs were developed at selected locations. National Weather Service Technical Paper Number 40 (Reference 3) was used in developing the 10-50-, and 100-year storms. The 500-year storm was based on extrapolated data. Frequency peak discharges at selected locations were computed. Drainage area-peak discharge relationships for each stream studied are shown in Table 1, "Summary of Discharges." The peak discharges for the 10-year frequency on Bear Creek are attenuated in the downstream direction due to storage in the overbank areas.

TABLE 1 - SUMMARY OF DISCHARGES

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (sq. miles) | PEAK DISCHARGES (cfs) 10-YEAR | 50-YEAR | 100-YEAR | 500-YEAR |
|---|---|---|---|---|---|
| BEAR CREEK | | | | | |
| Below Tributary BB-1*** | 42.86 | 11,100 | 17,900 | 22,000 | 30,800 |
| Below Tributary BB-3 | 37.41 | 11,400 | 17,700 | 21,300 | 29,000 |
| At State Highway 26 (Old 121) | 30.27 | 9,400 | 15,100 | 18,300 | 24,500 |
| TRIBUTARY BB-1 | | | | | |
| Above Big Bear Creek | 1.17 | 1,200 | 1,700 | 1,900 | 2,400 |
| TRIBUTARY BB-2 | | | | | |
| Above Big Bear Creek | 1.26 | 1,400 | 1,950 | 2,200 | 2,750 |
| At Trigg Street | 1.11 | 1,400 | 1,950 | 2,200 | 2,750 |
| TRIBUTARY BB-3 | | | | | |
| Above Big Bear Creek | 1.72 | 2,000 | 2,800 | 3,150 | 3,950 |
| Below Tributary BB-3A | 1.66 | 2,000 | 2,800 | 3,150 | 3,950 |
| Above Tributary BB-3A | 1.03 | 1,250 | 1,750 | 1,950 | 2,500 |

TABLE 1 - SUMMARY OF DISCHARGES (cont.)

| | | | | | |
|---|---|---|---|---|---|
| TRIBUTARY BB-5 | | | | | |
| Above Big Bear Creek | 1.86 | 2,050 | 2,900 | 3,250 | 4,150 |
| Below Tributary BB-5A | 1.81 | 2,050 | 2,900 | 3,250 | 4,150 |
| Above Tributary BB-5A | .93 | 900 | 1,300 | 1,450 | 1,850 |
| DENTON CREEK | | | | | |
| At Tarrant County line* | 3.96 | 6,000 | 8,300 | 9,400 | 36,200 |
| Below Tributary D-1 | 3.61** | 5,900 | 8,000 | 9,400 | 36,200 |
| Above Tributary D-1* | 2.42** | 4,050 | 5,500 | 9,400 | 36,200 |
| Above Tributary D-2* | 1.60 | 2,550 | 3,500 | 3,900 | 4,900 |
| Above Grapevine Lake outlet channel* | 1.19 | 2,050 | 2,800 | 3,100 | 3,900 |
| COTTONWOOD BRANCH | | | | | |
| At State Road*** | 4.69 | 3,600 | 5,000 | 5,600 | 7,100 |
| At Bethel Road | 3.64 | 3,600 | 5,000 | 5,600 | 7,100 |

*Discharges for Denton Creek below Grapevine Dam controlled by outflows from Grapevine Lake.
**Drainage area below Grapevine Lake.
***Outside corporate limits.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding sources studied in detail in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of the flood sources.

Cross section data for the streams in the study area were obtained by field surveys. All bridges and culverts were field surveyed to obtain elevation data and structural geometry. Cross sections were located at close intervals upstream and downstream of bridges and culverts in order to compute significant backwater effects of these structures. The locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Roughness coefficients (Manning's "n") for the computations were estimated on the basis of field inspections of the flood plain areas. Following is a list of "n" value ranges.

| | Roughness Coefficients Manning's "n" Values | |
|---|---|---|
| Stream Name | Channel | Overbank |
| Bear Creek | 0.060-0.030 | 0.085-0.070 |
| Tributary BB-3 | 0.065-0.055 | 0.075-0.065 |
| Tributary BB-5 | 0.065-0.055 | 0.085-0.075 |
| Denton Creek | 0.045-0.045 | 0.060-0.040 |
| Cottonwood Branch | 0.060-0.030 | 0.075-0.060 |

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.1 foot for floods of the selected recurrence intervals (Exhibit 1). Water-surface elevations of floods of the selected recurrence intervals were computed using the Corps of Engineers HEC-2 step-water computer program (Reference 4). Water-surface elevations for Denton Creek were computed using LRD-1 (Modified) water-surface profile computer program (Reference 5).

The flood profiles for Bear Creek were compared to previous studies for verification of results (Reference 1). Bear Creek was started by known water-surface elevations at the corporate limits. Denton Creek starting water-surface elevation was based on a rating curve. The remaining streams starting water-surface elevations were based on slope area determinations. All elevations are measured from National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in the study are shown on the maps. For study purposes, it was assumed that no clogging would occur and that all bridge structures would stand intact. Significant changes in this premise, imposed by differing conditions of a future flood, could alter the estimated flood elevations and flood limits shown on profiles and maps. The hydraulic analyses for this study, however, are based only on the effect of unobstructed flow. The flood elevations as shown on the profiles are thus considered valid only if hydraulic structures in general remain unobstructed and do not fail.

## 4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

### 4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FEMA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and the 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using the available topographic maps at scale of 1:9,600 with a contour interval of 10 feet (Reference 6). In cases where the 100- and the 500-year flood boundaries are close together, only the 100-year boundary has been shown. The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Maps (Exhibit 3). Small areas within the flood boundaries may lie above the flood elevations therefore not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

## 4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the FEMA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 3), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

BEST DOCUMENT AVAILABLE

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FT.) | SECTION AREA (SQ. FT.) | MEAN VELOCITY (F.P.S.) | REGULATORY (NGVD) | WITHOUT FLOODWAY (NGVD) | WITH FLOODWAY (NGVD) | INCREASE (FEET) |
| Bear Creek | | | | | | | | |
| A | 77,960 | 802[2] | 7,546 | 2.92 | 528.2 | 528.2 | 528.9 | 0.7 |
| B | 79,970 | 806[2] | 6,914 | 3.08 | 530.0 | 530.0 | 531.0 | 1.0 |
| C | 81,590 | 729[2] | 6,050 | 3.52 | 532.0 | 532.0 | 533.0 | 1.0 |
| D | 83,450 | 603 | 5,011 | 4.25 | 536.6 | 536.6 | 537.5 | 0.9 |
| E | 85,800 | 601 | 5,283 | 4.03 | 541.3 | 541.3 | 541.9 | 0.6 |
| F | 87,530 | 500 | 4,838 | 4.40 | 543.7 | 543.7 | 544.5 | 0.8 |
| G | 89,360 | 480 | 4,873 | 4.37 | 546.5 | 546.5 | 547.3 | 0.8 |
| H | 92,610 | 837 | 5,914 | 3.09 | 550.1 | 550.1 | 550.8 | 0.7 |
| I | 94,100 | 767 | 5,162 | 3.55 | 552.4 | 552.4 | 553.3 | 0.9 |
| J | 97,870 | 600 | 4,751 | 3.85 | 559.4 | 559.4 | 560.3 | 0.9 |
| K[3] | 105,100 | 770/510[3] | 6,070 | 3.01 | 572.7 | 572.7 | 573.5 | 0.8 |
| Tributary BB-1 | | | | | | | | |
| A | 2,020 | 112 | 390 | 4.87 | 523.0 | 523.0 | 523.9 | 0.9 |
| B | 2,520 | 49 | 353 | 5.38 | 526.1 | 526.1 | 527.1 | 1.0 |
| C | 3,300 | 56 | 424 | 4.48 | 530.4 | 530.4 | 531.4 | 1.0 |
| Tributary BB-2 | | | | | | | | |
| A | 2,760 | 65 | 355 | 6.2 | 538.2 | 538.2 | 539.1 | 0.9 |
| B | 4,620 | 55 | 313 | 7.0 | 550.3 | 550.3 | 550.7 | 0.4 |
| C | 5,130 | 78 | 435 | 5.1 | 556.0 | 556.0 | 556.6 | 0.6 |
| D | 6,200 | 69 | 487 | 4.5 | 562.3 | 562.3 | 563.3 | 1.0 |

[1]Stream distance in feet above mouth.
[2]Portion of floodway lies within Dallas-Fort Worth Airport boundary.
[3]Total floodway/floodway within corporate limits.

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

**CITY OF GRAPEVINE, TX**
**(TARRANT AND DALLAS COS.)**

**FLOODWAY DATA**

**BEAR CREEK-TRIBUTARY BB-1-TRIBUTARY BB-2**

BEST DOCUMENT AVAILABLE

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE | WIDTH (FT.) | SECTION AREA (SQ. FT.) | MEAN VELOCITY (F.P.S.) | REGULATORY (NGVD) | WITHOUT FLOODWAY (NGVD) | WITH FLOODWAY (NGVD) | INCREASE (FEET) |
| Tributary BB-3 | | | | | | | | |
| A | 1,670 | 124 | 754 | 4.18 | 546.2 | 546.2 | 547.2 | 1.0 |
| B | 2,300 | 84 | 490 | 6.43 | 549.0 | 549.0 | 549.7 | 0.7 |
| Tributary BB-5 | | | | | | | | |
| A | 1,620 | 95 | 603 | 5.39 | 560.5 | 560.5 | 561.3 | 0.8 |
| B | 2,380 | 82 | 616 | 2.35 | 562.3 | 562.3 | 563.2 | 0.9 |
| Denton Creek | | | | | | | | |
| A | 49,950[1] | 1250/980[3] | 6,248 | 1.57 | 471.9 | 471.9 | 472.6 | 0.7 |
| B | 51,350[1] | 610 | 3,615 | 2.60 | 472.4 | 472.4 | 473.1 | 0.7 |
| C | 53,350[1] | 474 | 3,419 | 2.75 | 472.9 | 472.9 | 473.7 | 0.8 |
| Cottonwood Branch | | | | | | | | |
| A | 22,510[2] | 313 | 1,650 | 2.46 | 523.6 | 523.6 | 524.6 | 1.0 |
| B | 24,320[2] | 154 | 1,234 | 4.54 | 529.6 | 529.6 | 530.5 | 0.9 |
| C | 25,620[2] | 261 | 1,731 | 3.23 | 532.3 | 532.3 | 533.1 | 0.8 |
| D | 30,200[2] | 288 | 2,404 | 2.58 | 556.1 | 556.1 | 556.1 | 0.0 |
| E | 31,000[2] | 320 | 2,429 | 2.55 | 556.2 | 556.2 | 556.3 | 0.1 |
| F | 33,710[2] | 300 | 1,671 | 3.71 | 561.8 | 561.8 | 562.5 | 0.7 |

[1] Stream distance in feet above mouth.
[2] Stream distance in feet above confluence with Denton Creek.
[3] Total floodway/floodway within Grapevine corporate limits.

TABLE 2

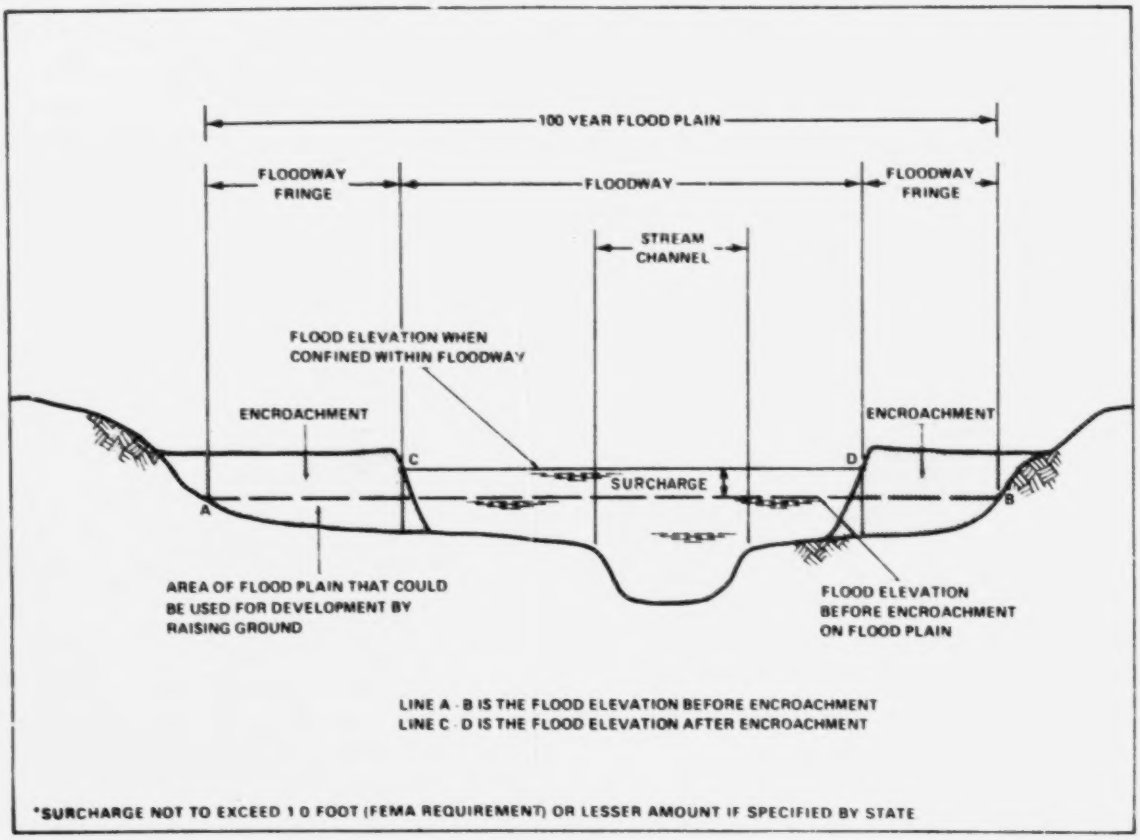
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF GRAPEVINE, TX
(TARRANT AND DALLAS COS.)

FLOODWAY DATA

TRIBUTARY BB-3-TRIBUTARY BB-5-
DENTON CREEK-COTTONWOOD BRANCH

BEST DOCUMENT AVAILABLE


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FLOODWAY SCHEMATIC Figure 2

## 5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, FEMA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for each significant flooding source affecting the City of Grapevine.

## 5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

| Average Difference Between 10- and 100-Year Floods | Variation |
|---|---|
| Less than 2 feet | 0.5 foot |
| 2 to 7 feet | 1.0 foot |

Thirteen reaches meeting the above criteria were required for the flooding sources affecting the City of Grapevine. These include one for Bear Creek, Tributary BB-1, Tributary BB-2, Tributary BB-3, Tributary BB-5, Denton Creek, Grapevine Lake and six for Cottonwood Branch.

## 5.2 Flood Hazard Factors (FHFs)

The Flood Hazard Factor is used to correlate flood information with insurance rate tables. Correlations between property damages from floods and their assigned FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between the water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, the accuracy for the FHF is to the nearest foot.

## 5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of Grapevine was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations.

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.



BEST DOCUMENT AVAILABLE

| | |
|---|---|
| Zones A2,A3,A4,A6, A13 and A22: | Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHFs. |
| Zone B: | Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; or areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided. |
| Zone C: | Areas of minimal flooding. |

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevation for each flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for Grapevine is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by FEMA.

## 6.0 OTHER STUDIES

A Flood Plain Information Report entitled, Bear Creek, Dallas and Tarrant Counties, Texas (Reference 1) was prepared by the Corps of Engineers and published in June 1971. The profiles developed in this report are in reasonable agreement with those in the present study considering differences in watershed and stream conditions and the fact that additional cross sections were obtained for this study. Since each of these studies was made by the Corps of Engineers, reconciliation of these differences was made within the agency.

Flood insurance studies for the adjacent cities of Colleyville, Southlake, and Keller are being prepared concurrently with this study; therefore, no conflicts in data are expected.

BEST DOCUMENT AVAILABLE

| FLOODING SOURCE | PANEL[1] | ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND | | | FHF | ZONE | BASE FLOOD ELEVATION[3] |
|---|---|---|---|---|---|---|---|
| | | 10% (10 YR.) | 2% (50 YR.) | 0.2% (500 YR.) | | | |
| Bear Creek Reach 1 | 0015 | -2.9 | -0.9 | +1.6 | 030 | A6 | Varies |
| Tributary BB-1 Reach 1 | 0015,0020 | -1.1 | -0.3 | +0.5 | 010 | A2 | Varies |
| Tributary BB-2 Reach 1 | 0015 | -1.2 | -0.3 | +0.6 | 010 | A2 | Varies |
| Tributary BB-3 Reach 1 | 0015 | -1.0 | -0.2 | +0.5 | 010 | A2 | Varies |
| Tributary BB-5 Reach 1 | 0015 | -1.4 | -0.3 | +0.8 | 015 | A3 | Varies |
| Denton Creek Reach 1 | 0010 | -1.4 | -0.7 | +0.9 | 015 | A3 | Varies |

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT-SEE MAP

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

**CITY OF GRAPEVINE, TX**
**(TARRANT AND DALLAS COS.)**

**FLOOD INSURANCE ZONE DATA**

**BEAR CREEK-TRIBUTARY BB-1-TRIBUTARY BB-2-TRIBUTARY BB-3-TRIBUTARY BB-5-DENTON CREEK**

| FLOODING SOURCE | PANEL[1] | ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND | | | FHF | ZONE | BASE FLOOD ELEVATION[3] |
|---|---|---|---|---|---|---|---|
| | | 10% (10 YR.) | 2% (50 YR.) | 0.2% (500 YR.) | | | |
| Cottonwood Branch | | | | | | | |
| Reach 1 | 0010 | -1.3 | -0.4 | +0.5 | 015 | A3 | Varies |
| Reach 2 | 0010 | -2.2 | -0.7 | +0.9 | 020 | A4 | Varies |
| Reach 3 | 0010 | -6.6 | -2.6 | +1.9 | 065 | A13 | Varies |
| Reach 4 | 0010 | -1.2 | -0.7 | +1.5 | 010 | A2 | Varies |
| Reach 5 | 0010,0020 | -2.1 | -0.7 | +1.4 | 020 | A4 | Varies |
| Reach 6 | 0020 | -0.8 | -0.2 | +0.7 | 010 | A2 | Varies |
| Grapevine Lake | | | | | | | |
| Reach 1 | 0005,0010 | -11.7 | -3.2 | +4.5 | 120 | A22 | 563.2 |

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT-SEE MAP

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF GRAPEVINE, TX
(TARRANT AND DALLAS COS.)

FLOOD INSURANCE ZONE DATA

COTTONWOOD BRANCH-GRAPEVINE LAKE

BEST DOCUMENT AVAILABLE

## 7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Federal Center, Denton, Texas 76201.

## 8.0 BIBLIOGRAPHY AND REFERENCES


1. U.S. Department of the Army, Corps of Engineers, Flood Plain Information Report, Bear Creek, Dallas and Tarrant Counties, Texas, June 1971.

2. U.S. Department of the Interior, Geological Survey, Stream Gaging Records.

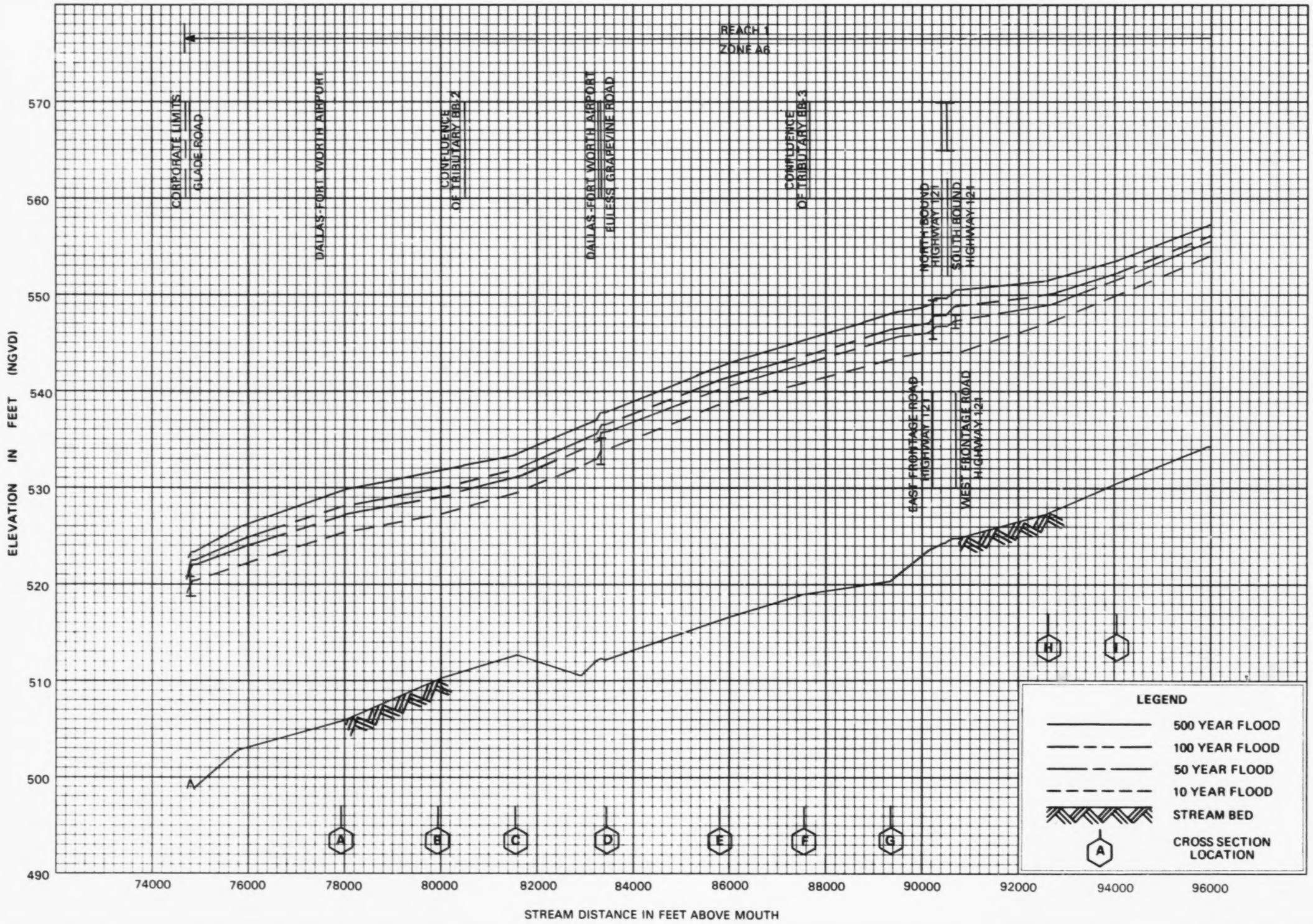
3. National Weather Service, Technical Paper Number 40, Rainfall Frequency Atlas of the United States, May 1961.

4. U.S. Department of the Army, Corps of Engineers, HEC-2, Water-Surface Profiles, Hydrologic Engineer Center, Davis, California, August 1979.

5. U.S. Department of the Army, Corps of Engineers, LRD-2 (Modified) Water-Surface Profiles, Little Rock District, Corps of Engineers, modified by Fort Worth District, Corps of Engineers.

6. U.S. Department of the Interior, Geological Survey - 7.5-Minute Quadrangle Maps: Colleyville, Texas, and Grapevine, Texas, both dated 1959 and photorevised in 1968 and 1973, scale 1" = 800', contour interval 10'.

BEST DOCUMENT AVAILABLE




FLOOD PROFILES

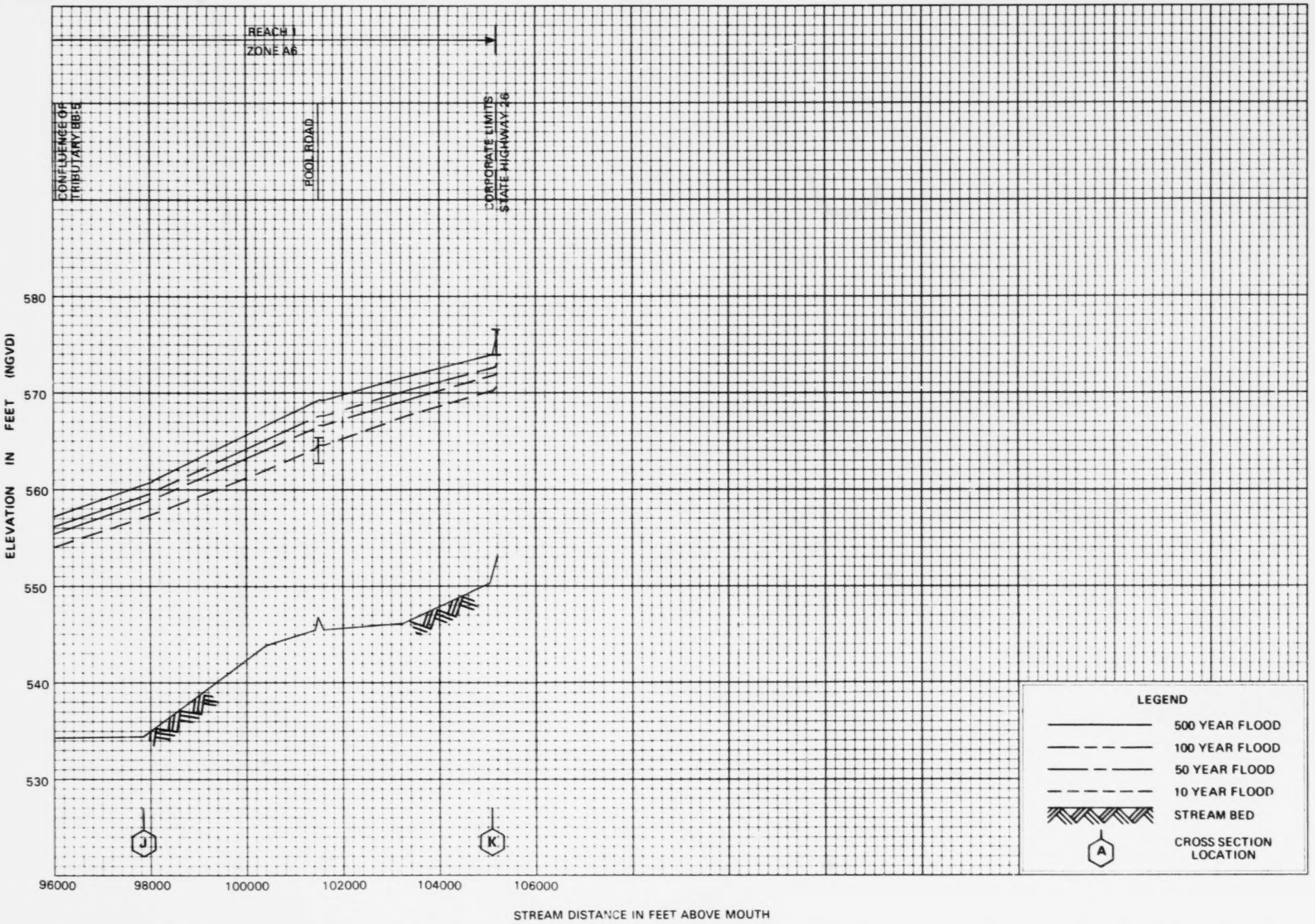
BEAR CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GRAPEVINE, TX
(TARRANT AND DALLAS COS.)

01P

BEST DOCUMENT AVAILABLE




FLOOD PROFILES

BEAR CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GRAPEVINE, TX

(TARRANT AND DALLAS COS.)

02P

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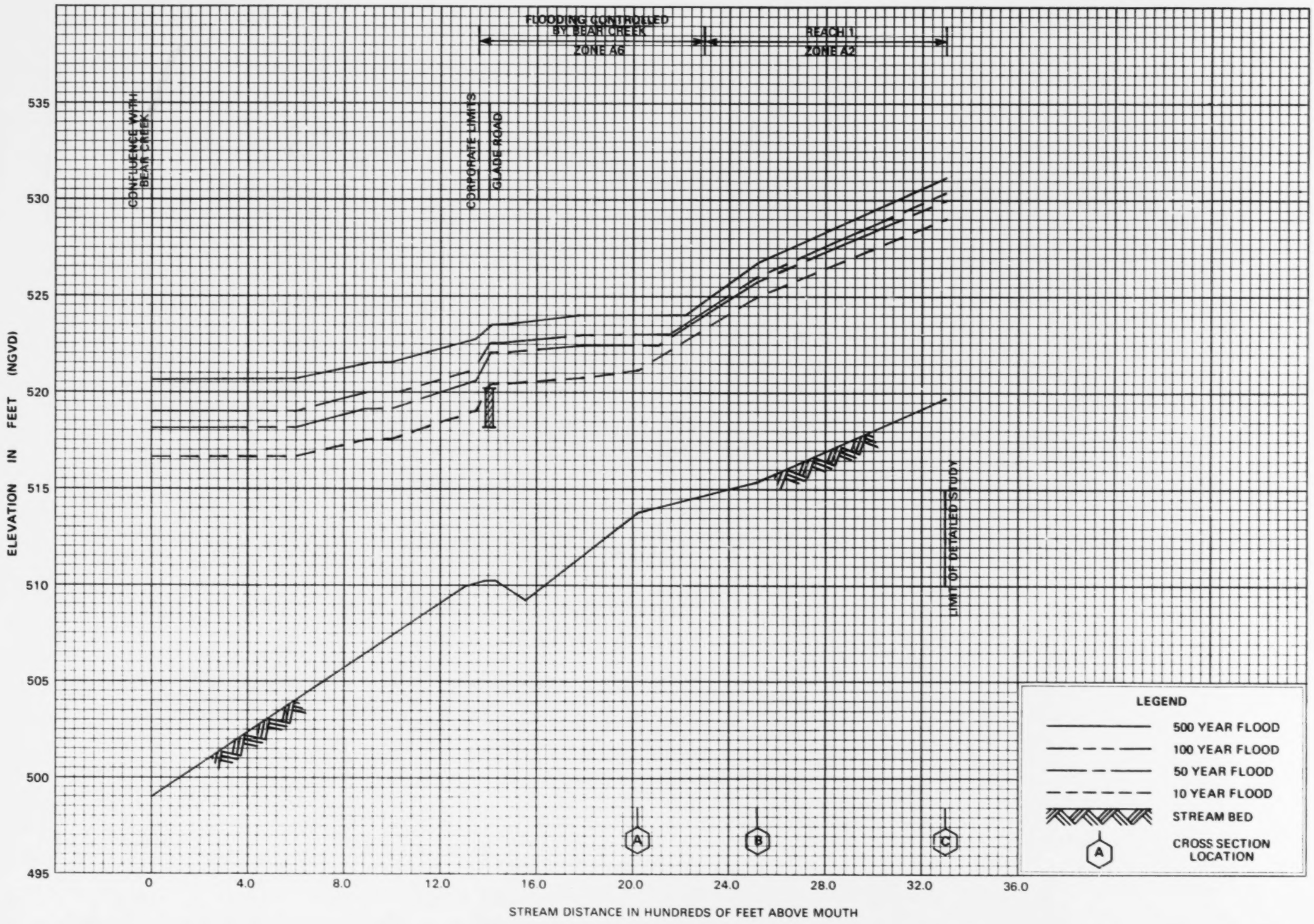



FLOOD PROFILES

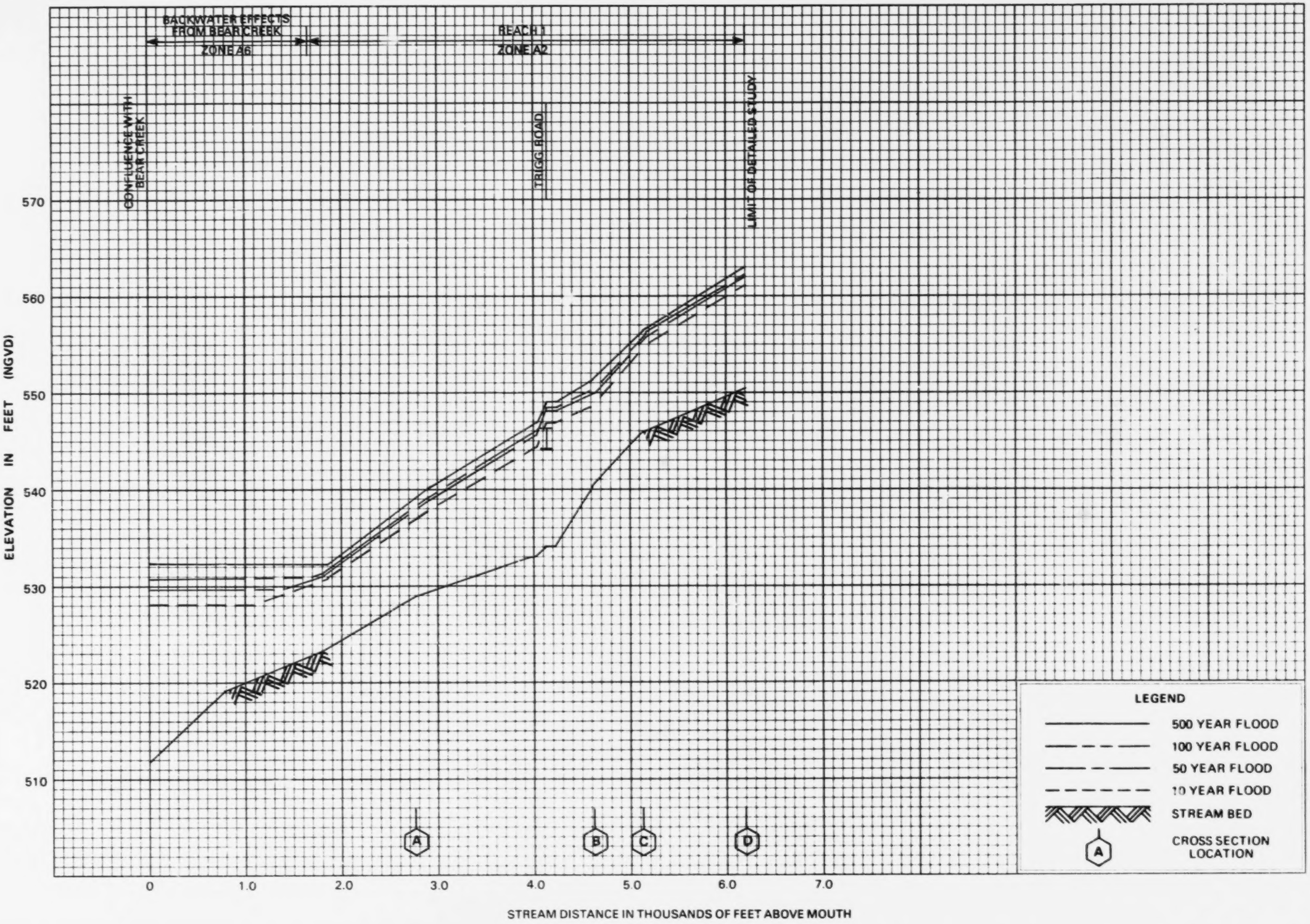
TRIBUTARY BB-1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GRAPEVINE, TX
(TARRANT AND DALLAS COS.)

03P

BEST DOCUMENT AVAILABLE




FLOOD PROFILES

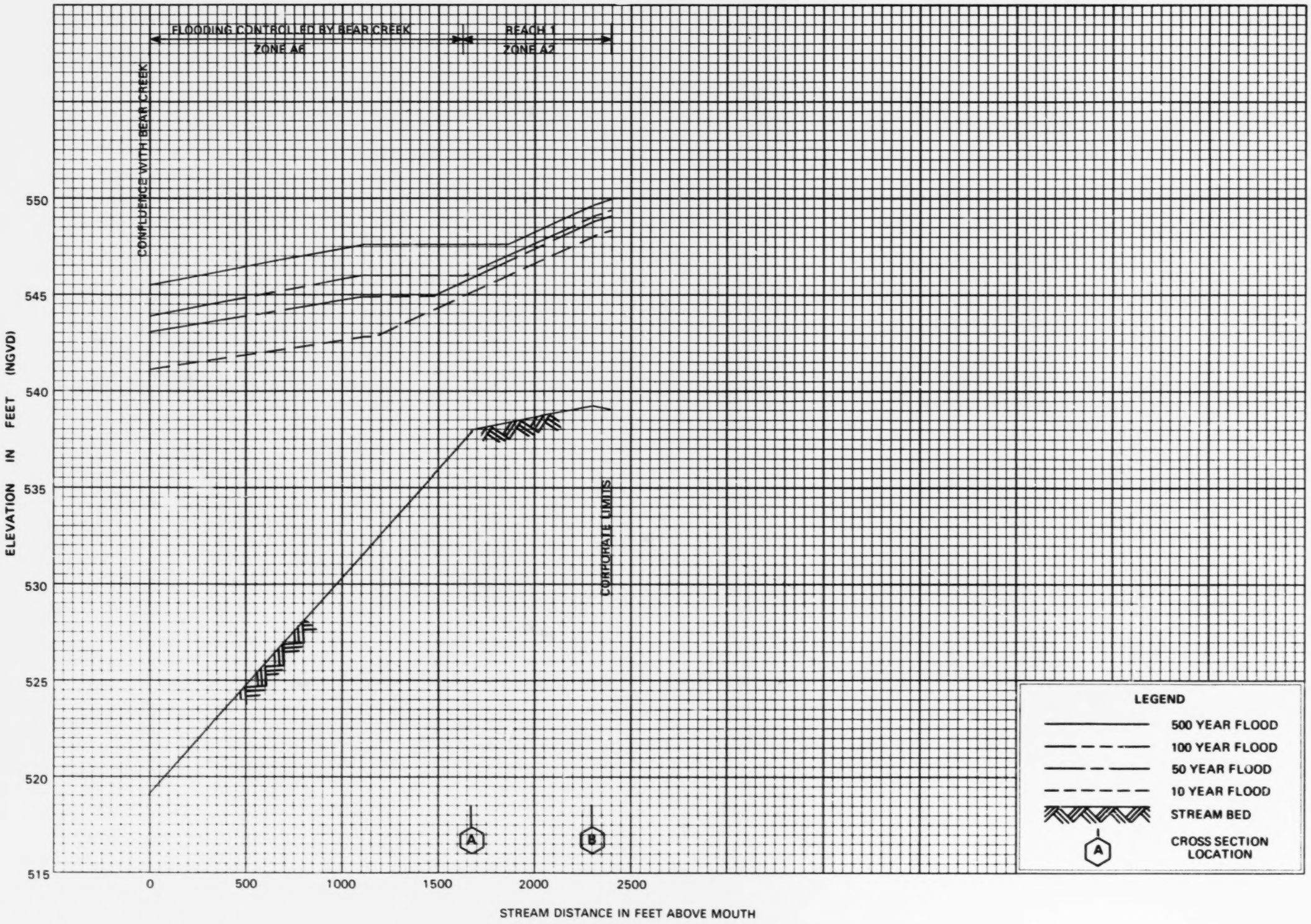
TRIBUTARY BB-2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GRAPEVINE, TX
(TARRANT AND DALLAS COS.)

04P

BEST DOCUMENT AVAILABLE




FLOOD PROFILES

TRIBUTARY BB-3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GRAPEVINE, TX
(TARRANT AND DALLAS COS.)

05P

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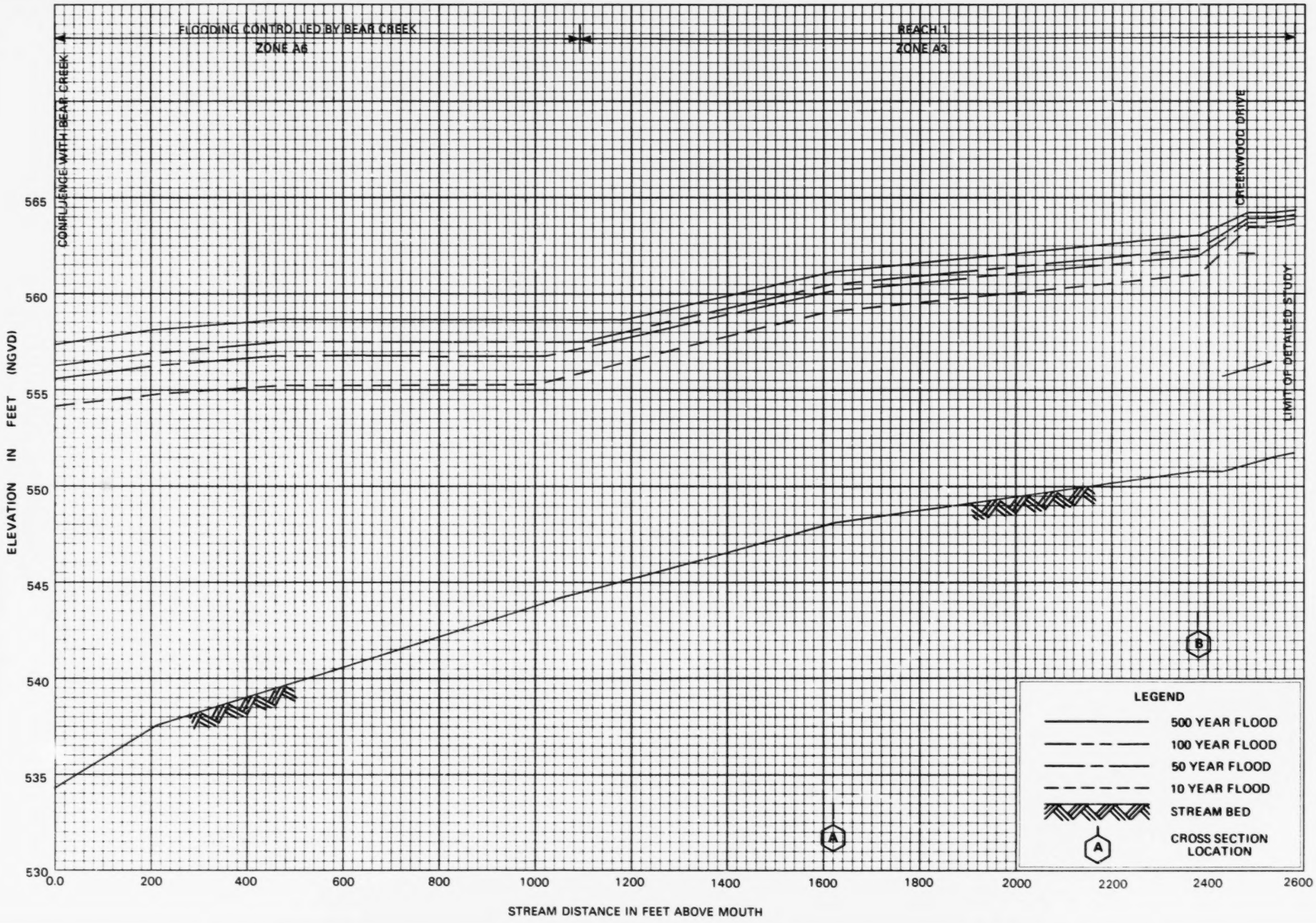



# FLOOD PROFILES

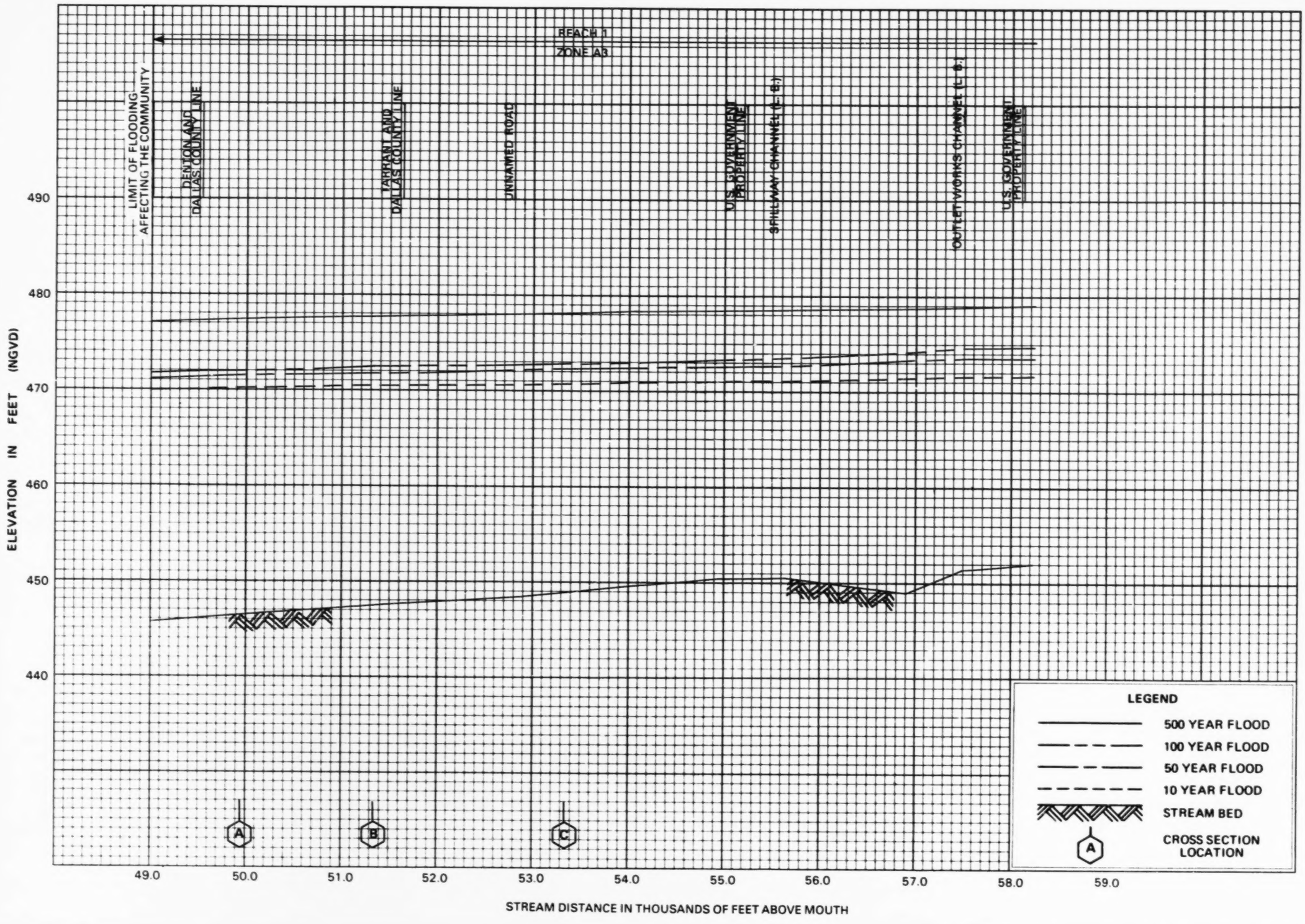
## TRIBUTARY BB-5

FEDERAL EMERGENCY MANAGEMENT AGENCY

**CITY OF GRAPEVINE, TX**
(TARRANT AND DALLAS COS.)

**06P**

BEST DOCUMENT AVAILABLE




FLOOD PROFILES

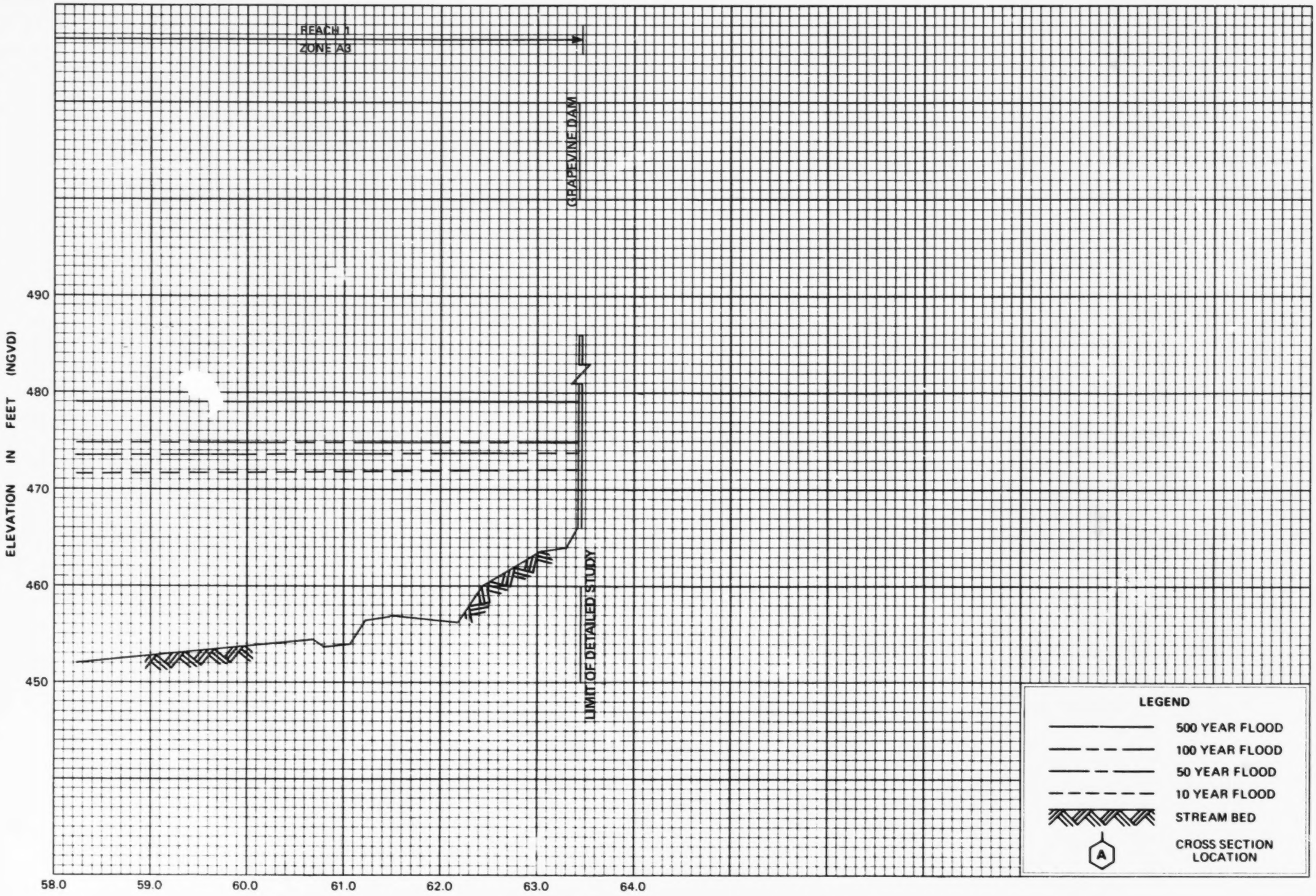
DENTON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GRAPEVINE, TX
(TARRANT AND DALLAS COS.)

07P

BEST DOCUMENT AVAILABLE




FLOOD PROFILES

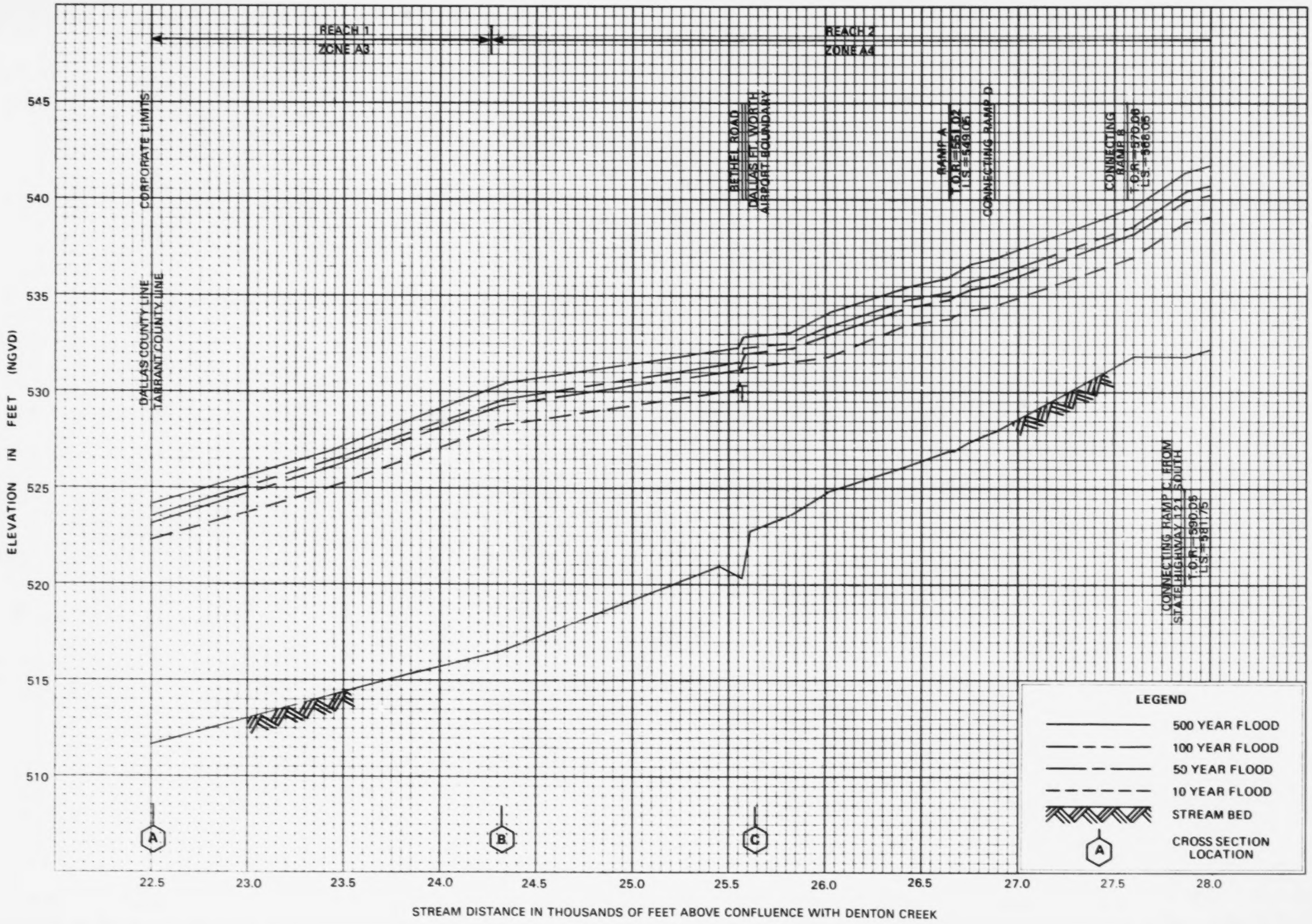
DENTON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GRAPEVINE, TX
(TARRANT AND DALLAS COS.)

08P

BEST DOCUMENT AVAILABLE




FLOOD PROFILES

COTTONWOOD BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GRAPEVINE, TX

(TARRANT AND DALLAS COS.)

09P

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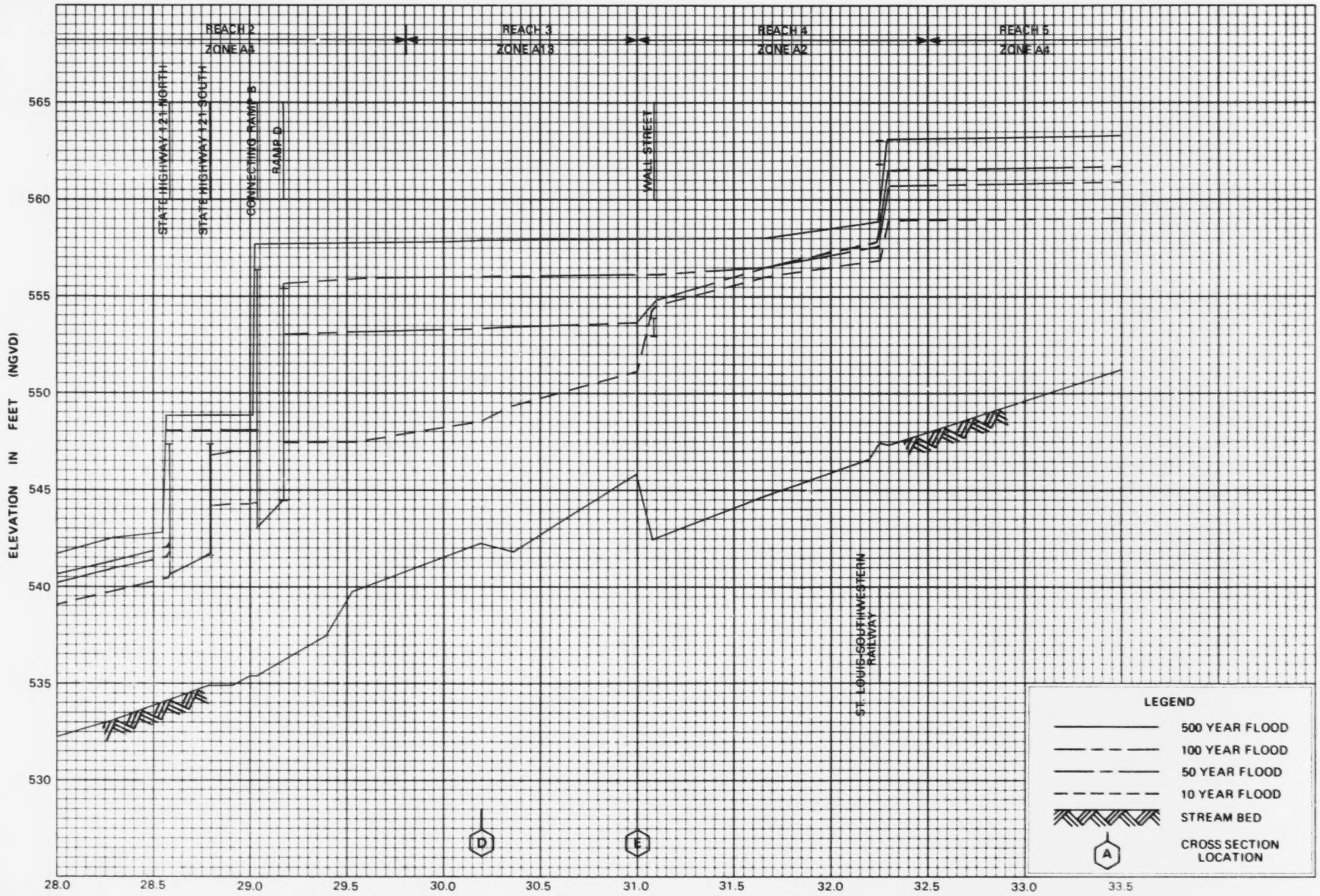


# FLOOD PROFILES

## COTTONWOOD BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

## CITY OF GRAPEVINE, TX

(TARRANT AND DALLAS COS.)

10P

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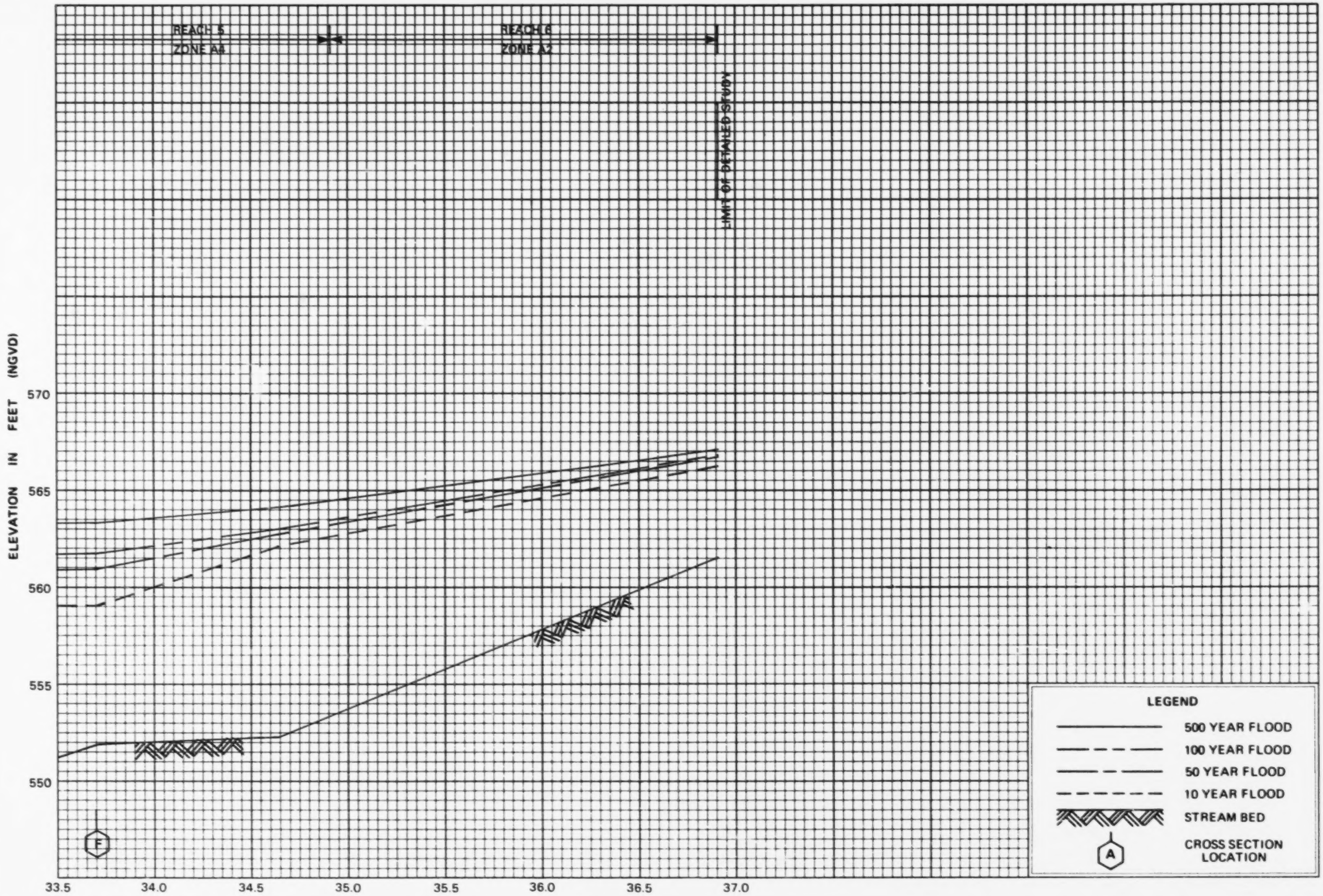


STREAM DISTANCE IN THOUSANDS OF FEET ABOVE CONFLUENCE WITH DENTON CREEK

FLOOD PROFILES

COTTONWOOD BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GRAPEVINE, TX
(TARRANT AND DALLAS COS.)

11P